Identifying Aquifers with Major Water Supply Potential in Region of Low Precipitation, Brazil

Technical expertise and collaboration reveal significant groundwater resources

CHALLENGE
Evaluate the water supply potential in region of Bahia, Brazil, characterized by limited rainfall and high evaporation rates.

SOLUTION
Assess aquifer potential and well salinization mechanisms using Schlumberger advanced simulation and visualization capabilities in close collaboration with Bahia's Water Resources Public Agency (CERB).

RESULTS
- Revealed significant additional water production capacity.
- Projected future abstraction scenarios and their impact on groundwater salinity in production wells.
- Enabled government to plan water-dependent initiatives benefiting more than 1 million people.

Aquifers had unknown potential
The Tucano sedimentary basin is part of the Recôncavo-Tucano-Jatobá rift, which encompasses approximately 47,000 km2 in eastern Bahia, Brazil. This region is known for limited precipitation (750 mm/year on average) and high evaporation rates (about 1,300 mm/year), making surface water scarce for approximately 1.2 million people.

At the same time, the Tucano basin is home to two important aquifers—the São Sebastião and Marizal. With a combined thickness exceeding 2,000 m in places and with proven freshwater resources down to at least 450 m, these aquifers have historically been exploited by farmers and townspeople for water supply. However, exploitation has been ad hoc, without an accurate understanding of groundwater availability or the aquifers' full potential on a regional scale.

This lack of knowledge had significantly affected the local population. Development had been stopped or delayed because of fears of an unsustainable water supply and concerns about the long-term effects on the aquifers. The Bahia state government, through its Water Resources Public Agency (CERB), wanted to study the aquifers in greater detail to understand their true potential.

Government agency sought expertise and collaborative workflow
CERB teamed with Schlumberger Water Services to assess 3,700 km^2 of the central Tucano basin. Using extensive field data compiled by CERB over more than 40 years and the Visual MODFLOW* three-dimensional groundwater flow and contaminant transport modeling application, the team developed a regional groundwater flow model for the central basin. AquiferTest* graphical analysis and reporting of pumping test and slug test data expedited interpretation of the available pumping tests (more than 80), and AquaChem* management, analysis, and reporting of water quality data helped
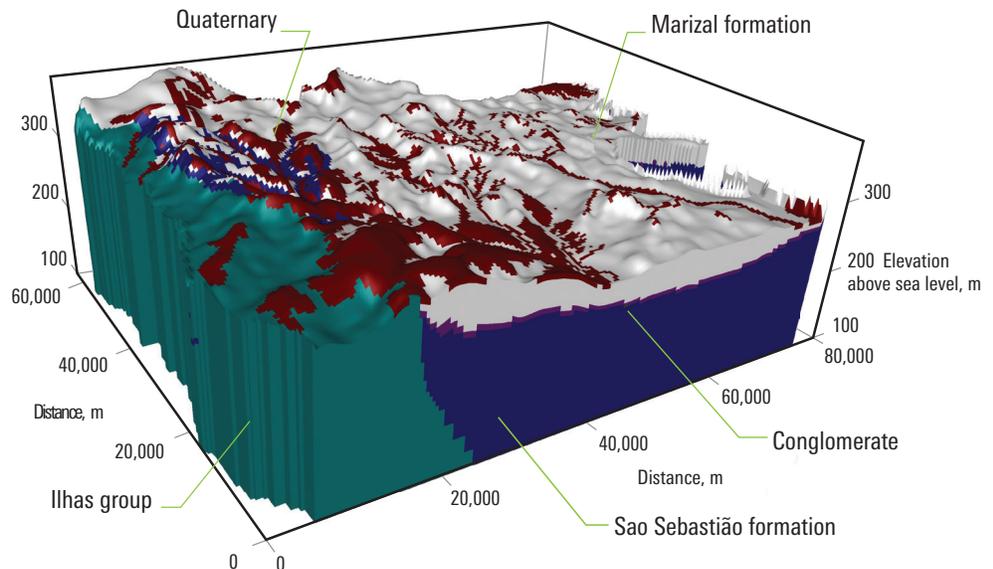
3D model illustrating the study area's geology, with the Ilhas group, a brown sandstone formation, in the west.

evaluate water chemistry data from existing wells, enabling the team to determine the aquifers' main hydrochemical properties and their lateral variations.

CERB and Schlumberger worked closely together throughout the modeling process. All interactions focused on the final objective—better management of the groundwater resources in a large region. Schlumberger implemented the work in phases, first building a sound conceptual model and then using it to create a numerical flow model. Each phase of the project included training to ensure full understanding among all team members before moving to the next phase.

The combination of modeling technology with technical expertise and mutual cooperation enabled the team to rapidly sort through large amounts of data—processing the most relevant information, filtering data for reliability, and focusing efforts on obtaining the best possible representation of the natural environment. The resulting model reproduced the current aquifer conditions and supported accurate projection of future abstraction scenarios.

### Project revealed significant water supply and drew national attention

Based on the modeling and interpretation results, the team concluded that the potential of the aquifers in the region had barely been exploited. Some wells are capable of producing more than 6 million liters of water per day. The existing groundwater abstraction rate could more than double across the basin without significantly affecting the aquifers.

The detailed characterization identified major water production potential for the state of Bahia and its population. This conclusion, together with the characterization of the aquifer hydrochemistry and mechanisms controlling the region's salinity, will play a key role in planning future groundwater abstraction and implementing water-dependent activities, such as agricultural irrigation.

Close collaboration between Schlumberger and CERB made the difference to the Tucano project. Its success led to a joint presentation in the national capital for numerous government agencies with an interest in the judicious use of water resources. In addition, the Rio de Janeiro American Chamber of Commerce awarded the team the 2014 Brazil Environmental Prize for "Rational Use of Water Resources," based on the project's originality, results, prevention of resource overexploitation, and potential social reach—benefiting more than 1 million people.

After project completion, Schlumberger transferred all the Visual MODFLOW application files to CERB. Using the technical training provided by Schlumberger, CERB will periodically update

the model and simulations. Future data collection will focus on aspects most relevant to better management of the Tucano basin's natural resources, such as determining the precise depth of the freshwater column within the São Sebastião formation.
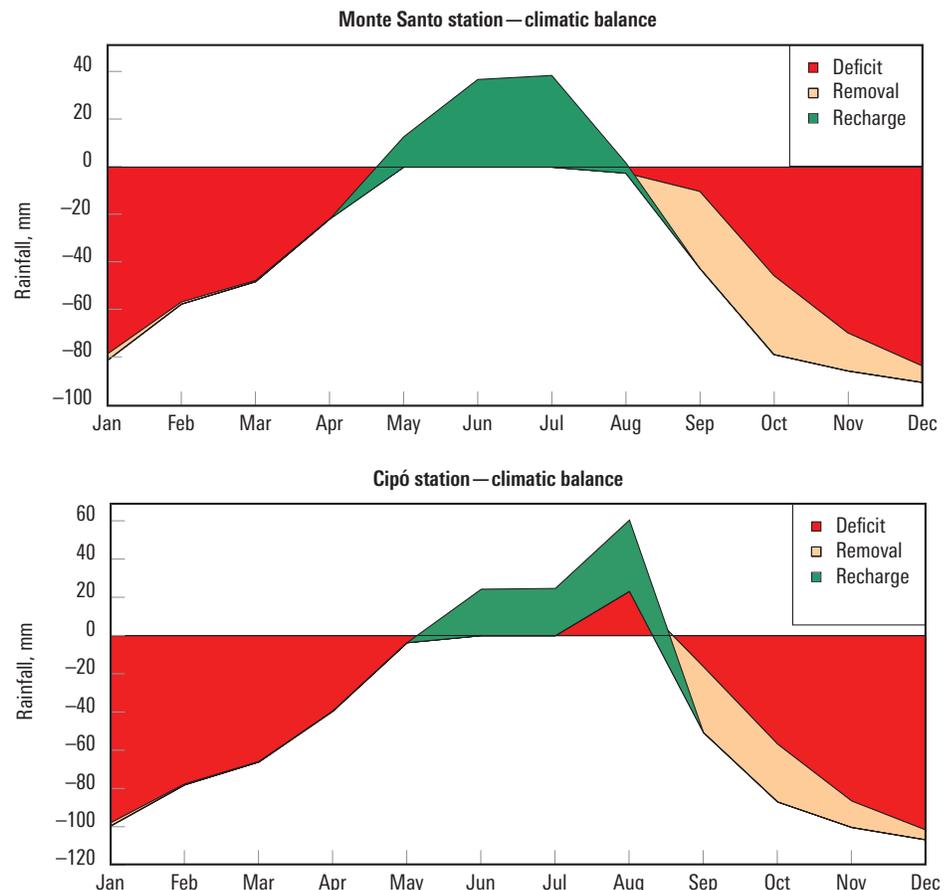
Climatic water balance in the central Tucano basin, showing periods of water deficit (red) and recharge (green). Source: Brazilian Meteorological Institute (INMET).

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